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OVERVIEW OF CONFERENCES WITH NON-FEDERAL USERS ON U.S. OPERATIONAL LAND REMOTE SENSING SATELLITE PROGRAM

Prepared for

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ABSTRACT

This report presents the discussions held at a series of NOAA conferences held in March, 1980, on the U.S. operational land remote sensing satellite program. The purpose of this report is two-fold. First, it provides those people not able to attend the conferences with essentially the same information that was discussed with conference attendees by NOAA and NASA personnel. Second, and more importantly, it contains a summary of the outputs of the fifteen user working groups at the conferences that provided information on their needs for the operational land remote sensing satellite program.

The five conferences were held in:

Seattle, Washington	March 14
Chicago, Illinois	March 17
Tallahassee, Florida	March 21
Washington, D.C.	March 25
Albuquerque, New Mexico	March 28

In each city a similar format was followed. The morning sessions were devoted to presentations by NOAA and NASA concerning the land remote sensing satellite program. The afternoon sessions were designed to provide a forum for land satellite data users to provide inputs to NOAA's planning process for the transition plan to be sent to OMB on June 1, 1980, and for the operational satellite system to be launched in the late 1980's.

The scope of the report is the decision process leading up to Presidential Directive NSC/54, the operational role that NOAA/NESS has had with regard to weather satellites, and the history of NASA's Landsat program. Further, this report explains NOAA's new role as the management agency for all operational civil remote sensing satellite programs and the planning process which will enable NOAA to take responsibility for the operational land remote sensing satellite program later in this decade.

The results from the working groups indicate that NOAA's perception of user needs was generally correct; that spatial resolution requirements are grouped into three categories (i.e., 10, 30-40, and 80 meters) and that the current MSS and TM bands satisfy most spectral requirements in the visible and solar infrared regions of the spectrum. Additionally, the groups recommended that:

- The private sector have some formal input to NOAA's planning process;
- Technology transfer and training activities should continue;
- Data should be archived as long as possible; and
- A quick-look capability is essential for an operational system.

The five user conferences and this report on their results are, in effect, the beginning round in a long series of interactions between NOAA and land satellite data users. While exact mechanisms for continuing this interaction have yet to be determined, establishing user interfaces is a top priority item with NOAA.

TABLE OF CONTENTS

	Page
ABSTRACT	i
A. INTRODUCTION	1
1. Purpose, Scope, and Objectives of Conferences	1
2. Overview of Report	1
B. BACKGROUND	3
1. Implementing the Presidential Decision	3
2. NOAA/NESS - Previous and New Roles	4
3. NOAA's Planning Process	6
4. NASA's Continuing Role	8
C. CONFERENCE OVERVIEW	11
1. Conference Objectives	11
2. Structure of the Conferences	11
3. Participation Overview	12
D. NOAA'S PERCEPTION OF USER'S NEEDS	25
1. Introduction	25
2. Data Base Creation and Update	25
3. Summary	33
E. SUMMARY OF WORKING GROUP SESSIONS	35
1. Organization of Working Groups	35
2. Topical Group Meetings	35
3. Results of the Working Group Sessions	37
4. Summary	40
F. OVERALL BENEFITS DERIVED FROM CONFERENCES	41
G. NOAA'S FUTURE PLANS FOR USER INTERACTION	43
APPENDIX A. CURRENT STATUS OF LANDSAT	A-1
APPENDIX B. LIST OF PARTICIPANTS	B-1
APPENDIX C. LAND REMOTE SENSING NEEDS QUESTIONNAIRE	C-1



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A. INTRODUCTION

1. PURPOSE, SCOPE, AND OBJECTIVES OF CONFERENCES

The Presidential decision to go forward with the development of an operational land remote sensing satellite program was announced in November, 1979. The National Oceanic and Atmospheric Administration (NOAA), in the Department of Commerce, was designated to manage the program service for users of land remote sensing satellite data necessitates that NOAA understand fully the needs of the user community, and particularly those of non-federal users. It is also necessary for these non-federal users and NOAA to have a mechanism for continuing exchanges that will ensure that the operational system is as responsive to user needs as technology and available resources will allow.

The Presidential Directive specifically states that "the eventual operation by the private sector of our civil land remote sensing activities" is a national goal. Very difficult questions have to be faced and resolved, both by the private sector and the government, before the possible ways of reaching this goal can be settled upon. NOAA is just beginning to explore these possibilities. The issues are complex and it will take time to untangle them. NOAA's initial contacts with representative U.S. companies have resulted in the assurance that industry is willing to work with them to unwrap each layer of the problem until core conclusions are revealed.

The ultimate configuration of the operational system will depend on how the private sector involvement effort develops. Although this has the effect of making it difficult to determine how user demands will be met by the operational system, it is also true that the system will be designed to meet those demands to which users attach the greatest importance and which technology and resources make it possible to achieve.

Five on-day conferences were held to inform non-federal users of the program planning underway within NOAA and to acquaint them with NOAA and NESS. The purpose of these conferences was to gather more information about the requirements of non-federal users and to establish mechanisms for continuing exchanges between these users and NOAA. The scope of the conferences included state and local governments, corporate end users, value added services companies, research and academic interests, and individual users and interpretation practitioners. Federal user requirements are being assembled separately and thus were not a major topic of discussion at these conferences.

NOAA will use the information obtained at the conferences to complete the requirements based upon which the transition planning and operational system evaluation processes will rest. Conceptual system designs can neither be undertaken nor evaluated without complete requirements information. The size of the private investment in the operational system cannot be estimated until this information is available. The impacts of policy decisions cannot be foreseen fully without it. A complete and well-described set of system requirements will be the keystone of NOAA's planning structure.

2. OVERVIEW OF REPORT

The next chapter of this report presents background information on NOAA's implementation of the Presidential Directive, NOAA/NESS's previous and new roles, NOAA's planning process from today's Landsat system to the future operational system, and NASA's continuing role. Chapter 3 presents a conference overview, including the structure of the programs and an overview of the participation.

The fourth chapter provides information on NOAA's perception of users' needs followed by a summary of the working group sessions in Chapter 5. Chapters 6 and 7 deal respectively with the overall benefits derived from the conferences and NOAA's future plans for user interaction.

The current status of Landsat is presented in Appendix A. Appendix B provides a list of names and addresses of conference participants. Appendix C contains a copy of the user requirements questionnaire that conference attendees were requested to complete.

B. BACKGROUND

1. IMPLEMENTING THE PRESIDENTIAL DECISION

Early in his administration, President Carter directed a comprehensive review of the nation's space policy. This review resulted in the May, 1978, issuance of Presidential Directive/NSC-37 which established the broad national policy framework within which future U.S. space activities were to be conducted. It also established the Policy Review Committee on Space as the specific executive mechanism for considering national space policy changes and for the quick handling of critical space issues.

The President directed that this newly-formed committee provide him with an assessment of the nation's future needs for civil space programs. Based on that assessment, Presidential Directive/NSC-42 was issued in October, 1978, mandating the active consideration of greater private sector involvement in remote sensing activities and the review of possible future organizational arrangements among agencies involved in land remote sensing. In his March, 1979, Science and Technology Message, the President announced the Administration's commitment to the continuity of land remote sensing satellite data, as well as to new initiatives in this area. These commitments were confirmed by the President in November, 1979, with the issuance of Presidential Directive/NSC-54, which mandated development of an operational land remote sensing satellite. Management responsibility for the civil operational land remote sensing satellite program was assigned to the National Environmental Satellite Service (NESS) within the Department of Commerce's National Oceanic and Atmospheric Administration (NOAA). In designating NOAA as the lead management agency for land satellite programs, the President acknowledged NOAA's prior experience in successfully operating and managing three generations of weather satellites. In addition, assignment of this responsibility to NOAA integrates all civil operational satellite activities in a single agency. NOAA will continue its current satellite responsibilities in both the areas of oceans and atmosphere.

One of NOAA's primary tasks is to develop a time-phased transition plan, in coordination with other appropriate agencies, for moving to a fully integrated satellite-based, land remote sensing program. This transition plan is to be submitted to the Office of Management and Budget by June 1, 1980, and will provide the framework within which the details of the interim and the final operational systems will be developed. The plan must cover the following subjects:

- The organization and implementation of a Program Board, chaired by Commerce and designed to provide continuing and effective federal coordination for satellite land remote sensing system activities;
- The design and implementation of a NOAA organizational structure that will ensure proper management of the program and appropriate development and enforcement of regulatory guidelines for the system's operation;
- The development of system financing options and recommendations that include data and product pricing policies which recognize the user's responsibility for sharing costs; a stated goal is the eventual operation of the system by private sector investors, functioning under federal authority;
- The technical design of the system, which will evolve from consideration of the requirements that the system must satisfy, the size of the investment that can be made, and the level of technology that can be incorporated into the system;
- The development of private and international user participation to distribute system benefits more broadly and to spread costs over a wider base of users;

- The identification of existing resources that are connected with the Landsat activity and which should be transferred before the advent of the operational system; included here is the need to determine the future organizational home and functions of the EROS Data Center; and
- The identification and recommendation of such executive orders and legislation that are considered to be needed by Commerce and NOAA to carry out this mission.

The plan, after its approval, will provide the framework for developing detailed plans and design for the interim operational system (based on Landsat technology), a fully operational system, moving toward the goal of private sector operation, and system management and financing. An approved transition plan is essential, both to provide a context for resolving program issues and as an outline for undertaking technical development of the system. Very long lead times are involved. Even with adequate funding, beginning in fiscal year 1981, a fully operational system cannot be implemented before about 1988.

To draft the transition plan, a NOAA task force was staffed by technical and policy people from various parts of NOAA, NASA, and the Departments of Interior, Agriculture, and State. They have consulted with other federal agencies and contacted national organizations, state and local governments, and several private sector groups to try and determine what the users' needs are.

The Program Board called for in the requirements for the transition plan will not be established until the plan is fully approved by the government. In the meantime, an Interim Policy Group (IPG) was established to provide NOAA with policy guidance and policy level representation and coordination with the key federal departments. The IPG is expected to validate the federal sector user requirements collected by the task force. Thus, users from the federal sector already have paths available to them for making their data and service requirements known. Through some existing associations, state and local government agencies have at least the beginnings of the mechanisms needed for making their requirements known. The Intergovernmental Science, Engineering, and Technology Advisory Panel (ISETAP), the National Governors' Association, the National Council of State Legislatures, the Council of State Governments, and other national and regional associations provide state and local governments with some data requirement input paths.

However, the needs of the private sector users are not understood as well as they need to be. In order for NOAA to fully understand the needs of the non-federal user community, a mechanism for continuing exchange between NOAA and the users was needed. For this purpose, a series of five conferences were held to acquaint the users with NOAA and NESS, to inform them of the program planning underway, to provide them with an opportunity to submit their known requirements for land remote sensing data, and to establish a viable mechanism by which NOAA could communicate with the users as plans develop and as user requirements evolve. Through this process, the NOAA operational land remote sensing satellite system of the late 1980's will be designed and operated to be as responsive to user requirements as technology and available resources will allow.

2. NOAA/NESS – PREVIOUS AND NEW ROLES

NOAA was established in the Department of Commerce by Presidential reorganization in 1970. In the words of that plan, NOAA's creation was intended to recognize that "the oceans and the atmosphere are interacting parts of the total environmental system upon which we depend not only for the quality of our lives, but for life itself." The Reorganization Plan directed NOAA to employ a unified approach that would lead to an increased knowledge of the oceans and atmosphere and which would allow them to expand opportunities in these areas. The Plan also directed NOAA to undertake a similar approach with respect to programs involving the solid earth. NOAA became the manager of the agencies now known as the National Weather Service, the National Environmental

Satellite Service, the Environmental Research Laboratories, and the Environmental Data and Information Service. The National Ocean Survey, which had its primary origin in the old Coast and Geodetic Survey, is also part of NOAA. Since 1970, NOAA has been assigned new responsibilities under a variety of legislative enactments dealing with marine and coastal protection, fisheries and climate.

The National Environmental Satellite Service (NESS), in which will reside NOAA's interests in the management of land remote sensing satellite programs, goes back much further than 1970. In 1959, a branch was set up in the U.S. Weather Bureau called the Meteorological Satellite Activities Branch. Now known as NESS, it has grown from three to 600 people and has gradually increased its activities in space.

The first meteorological satellite, called TIROS-1, was launched on April 1, 1960. By today's standards, the pictures which it returned were rather crude; but, at that time, it allowed people to see for the first time what models and research had predicted the weather to look like. From that time on, meteorological satellites have been in space, returning data for use in weather observations. In the mid-60's, that system became operational, meaning that the data are provided routinely and on a timely basis.

Today NESS operates two environmental satellite systems. The TIROS system has two satellites in complementary polar orbits and provides global data all day long. The TIROS, now called NOAA, program provides digital data and is used for monitoring clouds and weather as well as sea surface temperature and ice conditions.

The Geostationary Operational Environmental Satellite (GOES) system has a slightly different purpose. The polar (i.e., NOAA) satellites cross a given area of the earth about once every six hours. However, the GOES geostationary satellites are able to obtain imagery about once every half hour, and even more if needed, and are therefore used to track severe weather. Two satellites of the GOES series have been operating in space since the program started in 1974.

NESS's involvement in oceanic activities will increase with the currently proposed National Oceanic Satellite System (NOSS). NOSS is a five-year operational demonstration program which will be conducted jointly by NOAA, NASA, and the Department of Defense (DOD) through the Navy. NASA will share the responsibility for developing the space segment. DOD and NOAA will share the responsibility for funding the follow-on spacecraft as well as developing the ground system and operating the system once it is deployed. The NOSS program is expected to provide data on sea state, low level ocean winds, currents, turbidity, temperature, ocean chlorophyll, sea ice, and pollution.

In assigning to NOAA the management responsibility for all civil operational remote sensing satellite activities, the Presidential Directive recognized NOAA's experience and success in managing operational satellite programs. NOAA/NESS distributes the data and products from the operational meteorological systems from within a few minutes to a few hours of data acquisition. In addition to NOAA's real time activities, all of the data are recorded and turned over to the Environmental Data and Information Service (EDIS) where it is archived for retrospective users. EDIS also analyzes the data for certain information needs that they have and responds to customer requests to make copies of these data available to other users.

NESS is a data provider rather than a data user. As a service agency, its primary concern is the delivery of products that have been specified by authorized users. Although NESS is responsible for developing system improvements and for looking for ways to increase the benefits of applications, it does not have a true R&D role. The approach that NOAA and NESS follow is to base the operational satellite system on the space technology that has been developed and proven by NASA. The validated requirements of the users are matched against this proven technology to obtain the most responsive system possible. This approach has allowed new operational space and ground configurations to be implemented at minimum risk and with little disappointment.

The new land remote sensing task presents challenges to NOAA that are somewhat different from those encountered in the past. The user community is very diverse in its interests and requirements. Therefore, it is more difficult to aggregate and analyze the requirements and to ensure that the operational service is as responsive to the users as possible. There also exists among the users a great continuum of data timeliness requirements. Thus, there is a need to help the diverse user community to understand the long lead times from agreement on system requirements to full implementation of a system based on these requirements. That lead time to an operational system is optimistically about eight years.

Another aspect of an operational system is the stability of system design that is required for both data reliability and cost considerations. NOAA's experience with operational satellite systems has led to the conclusion that validated requirements should be the basis of system design and that the system should be built around proven space technology. Digging out the requirements, organizing them, and using them as a measuring stick are not easy or simple tasks. Confining the system design to proven elements when confronted with the conventional wisdom about imminent technological breakthroughs takes a special kind of restraint. This approach has worked well for NOAA in the past, however, and it is the approach which will be followed in the land program.

Organizationally, NOAA must provide the means for dealing with the new and complex tasks associated with the land satellite activity. The multi-agency task team that is putting the transition plan together is a temporary arrangement. The Administrator of NOAA has recommended that NESS become a NOAA main line component, with the director of NESS being appointed as a NOAA Assistant Administrator. This action, plus some staffing and organizational adjustments, will provide the functional mechanisms to allow NOAA and NESS to handle the land system's development with appropriate priority.

3. NOAA'S PLANNING PROCESS

Fundamental to outlining the path of the future NOAA operational system is a definition of "operational system." First, the system must be stable over time. It should make changes in the spacecraft and ground system hardware and process only when there is good need to do so and when the users have had time to be involved in the process of deciding when to make those changes and how to do them in some logical way. Users will only invest in the hardware/software procedures to extract information and hence use the data when they feel confident that the flow of data is reliable. This reliability depends on an adequate number of spacecraft in orbit, the ground system capacity and reliability to meet the stated goals, and some capability to provide limited services when the main functions of the spacecraft begin to fail.

Next, the system must not be stagnant. New capabilities will be developed through the NASA R&D and other programs. New applications will be developed and better, more economical ground processing techniques will come on line. However, it is essential for all users to be able to be involved in this change process. Most important, the users must perceive that the system is designed and functions to meet their needs. It is critical that the system be designed to meet user requirements, that it operate according to announced specifications, and that it be scoped so as to balance benefits against the costs.

In the coming years there will be three overlapping periods. The first period has already started and includes the operations of Landsats 3, D, and D', ground processing of data from these satellites, and advanced planning for the operational system. The second period depends on follow-on spacecraft, D'' or D''', an improved but interim ground system, and focused planning systems development for the operational system. The third period will depend on spacecraft with the new design, will introduce a custom design operational data processing and delivery system, and will

include studies leading to improved system performance and ultimately to the next generation of operational satellites. It is important to note that these three periods are not sequential, but overlap.

The first version of the operational system probably will not come on line until 1988. Even then, the full range of products and services that the users want may not be available due to technical and financial reasons. NOAA, working with NASA, Interior and other agencies, will start moving towards these goals as soon as possible.

NOAA is aware, as all of the users must be, that there are and always will be risks of a break in the continuity of data. This will always be the situation when such continuity depends on complex and highly technical space systems. There can be no 100% guarantee that the data will continue to flow all the time. In the early part of the transition period, between now and the time Landsat D is launched or becomes functional, data collection can be interrupted if there is an early failure of Landsat 3, if the launch of D is delayed by problems with the development of the sensors, if modifications must be made to the launch vehicle, or if there are delays in the availability of the TDRSS system. In a practical sense, those risks are too close for NOAA or NASA to really be able to do anything about them with new programmatic actions. NASA and NOAA will do everything possible to avoid them, but they must be recognized as risks.

Likewise, there are risks for interruption in processing data from Landsats 3, D, and D', but these risks are more amenable to avoidance. NOAA is working with NASA and DOI to identify system weak points, to improve the reliability and throughput, and to upgrade the R&D ground system to have the characteristics of an interim operational system, which is possible but expensive. There is no guarantee that the required funds will be available. In the period after D and D', but before the operational system comes on line, the outlook may be somewhat brighter. Landsat D'' and D''' could be built and operated and there is a greater possibility for upgrading the interim ground system. These solutions to the continuity problem are also expensive and some of the long leadtime parts should be ordered soon. Here again the budget situation in Fiscal '81 and '82 is very uncertain. NOAA is aware of the problems and will do everything possible within the available resources to overcome those problems.

The process that NOAA is following to define the need for the operational system, to resolve the many complex issues that are involved, and to bring the operational system into being, starts with a better understanding of user needs. The mainstream of this process is simple enough—to identify the user requirements of federal agencies, state and local governments, commercial end users, the academic community, foreign governments and foreign commercial users. Then, NOAA will evaluate existing and projected technological capabilities for spacecraft in particular to meet these needs, postulate one or more end to end data systems to meet various levels of requirements, compare the rough order of magnitude costs for each of these systems, and attempt to test each of these systems with the responsiveness to the broadest user community. NOAA will then negotiate with the private sector on management and financing of the system, and hopefully initiate the operational services later in this decade.

Unfortunately, as with most simple solutions to complex problems, there are many interconnected issues that will have to be resolved, some before the June 1 transition plan is delivered to the OMB, and some for which the best NOAA can do is identify a mechanism for resolving the issues. Interwoven issues relating to system financing, private investment, and data pricing policies will be very hard to unravel. Private investment will depend on the prospects of profitability, which, in turn, depends on government funding decisions and the type of data pricing policy that is finally approved. If prices are high, users will decline.

NOAA is tasked to establish user participation and to seek ways to have users share system costs. While it appears possible to charge end users a price for data that reflects the economic value of the information contained, it is national policy that there be consistent charges. Questions arise

such as how is the charge to be calculated? How are the value of the data to the public goods and services supplied by the federal agencies and state and local governments included in this calculation? How is the value to the commercial end user estimated? Is it more feasible to establish a single unit price for the data based on the cost to build and operate the system, with or without a general federal subsidy, and to provide special financial support to state and local governments?

Private sector investment in and eventual operation of the system is a goal. However, NOAA must assure that national needs are met by the system. Furthermore, the government must provide a mechanism which protects the proprietary interests of the private sector while, at the same time, maintaining direct readout capability at foreign ground stations. The government must encourage the development of complementary land remote sensing satellite systems on an operational basis, but protect against unwarranted transfer of U.S. technology. Foreign users of the U.S. system will be expected to pay the same price for data as domestic users.

All of these and other issues form a closed loop in which adjustments to one necessitate adjustments to all others. NOAA is addressing many of these issues in the transition plan, taking into account the user requirements presented at the five workshops. NOAA will process the requirement inputs and provide the information to a systems concept group. The systems concept group will massage these data, along with their perceptions of technical feasibility and economic viability, and propose alternative systems that meet the users' stated requirements. Two iteration loops will then be operating. First, NOAA will continue to interface with the users as they refine and update their data needs, and second, NOAA will be continuously feeding this new information to the systems concept group who, in turn, will be refining their system designs.

The whole technical process is exceedingly complex but NOAA expects to get a well defined operational system that can be presented to data users for their comments. Simultaneously, the operational system concept will be presented to industry to determine their willingness to develop or invest in this system or a modification thereof. Throughout the entire planning process, NOAA needs a mechanism to keep non-federal end users informed and involved. Several options are being considered, such as additional workshops/conferences, newsletters, presentations at professional meetings, and other similar techniques. NOAA also needs a formal mechanism for continually getting users' statements on requirements as they evolve and for providing a mechanism for non-federal users to have a voice in system design and the resolution of policy issues. Suggestions on such mechanisms were solicited at the workshops in order to assist NOAA in its planning process from today's Landsat to a future operational system.

4. NASA'S CONTINUING ROLE

NASA's role in research and development will not change with NOAA's management of the civil operational land remote sensing satellite program. NASA will continue to develop new remote sensing techniques and will continue to experiment with and develop new processing concepts. They will also experiment with techniques for the extraction of information from remote sensing data.

In the realm of scientific applications, NASA wants to expand the scientific data base for both the renewable and non-renewable resource areas and develop the relationship between observations and what is actually occurring on the ground. In addition to the in-house research, NASA works very closely with research efforts conducted by the Departments of Agriculture, Interior, and Commerce, and any other government agencies with similar interests. NASA also wants to have a continued and broadened relationship with research projects in industry and academia.

In the development of new technology, NASA will continue to achieve the best kind of technology for sensing the geodynamic and geological variables for better applications to the problems which occur in those areas. They also want to address the issues of better sensing for exploration

of minerals and energy materials, and an assessment of what is occurring in the earth, in both its gravity and electromagnetic field and in the actual dynamic movement around its axis and around the sun.

Regarding ground data processing concepts, NASA will work with NOAA to continue to try to improve them by preserving the accuracies of the data, by maintaining some kind of flexibility in processing the data rather than being locked into one mode, and by reducing the cost and increasing the throughput capability of the systems. NASA wants to continue to improve the capability to reconstruct, compare, resample, and register all of the data and try to work out the most efficient way to extract real, usable information from the data.

NASA has a 20-year pattern of excellent cooperation with NOAA in the weather satellite field and hopes to continue that pattern. They hope and understand that NOAA will be able to help them better understand what the customer requirements are. This doesn't mean that 100% of their contacts with the customers will all be through NOAA, but the primary contact will be through the NOAA. NASA will continue with the relationships it now has with the user community except where a better working relationship with NOAA and the customer can be developed. NASA acts as a prime contractor for NOAA for developing new systems which NOAA funds, and NASA would probably continue that relationship for the land remote sensing system.

The joint NASA/user projects currently underway are not planned to be cut back or eliminated in any way, but they will undergo a phased change in order to get the best benefit for both the government and for the private sector. For example, NASA regional remote sensing application programs are involved with making people aware of what is available, training the people to take advantage of it, demonstrating some of the applications, and providing some technical assistance. This kind of relationship would best come from NASA leading the user by the hand, through a NASA/NOAA customer-type relationship of some sort yet to be defined, until finally the user is independent of the government agencies and able to make the best use of all the data that is being piped down. NASA hopes to be able to show that this plan is economically beneficial and technically workable. The ultimate goal is complete independence of the user.

C. CONFERENCE OVERVIEW

1. CONFERENCE OBJECTIVES

The Presidential decision to go forward with the development of an operational land remote sensing satellite program was announced in November, 1979. The National Oceanic and Atmospheric Administration (NOAA), in the Department of Commerce, was designated to manage the program. NOAA, through its National Environmental Satellite Service (NESS), has been conducting the nation's civilian operational meteorological satellite program since 1966.

Developing an operational service for users of land remote sensing satellite systems calls for NOAA to understand fully the needs of the user community, and particularly of non-federal users. It also makes it necessary for these non-federal users and NOAA, together, to establish and continue a dialogue that will ensure that the operational system is as responsive to user needs as technology and available resources will allow.

NOAA is required to produce a time-phased transition plan for these land remote sensing activities and to submit it to the Office of Management and Budget by June 1, 1980. The plan is to cover:

- Establishment of a program board for continuing federal coordination;
- Organization for management and regulation;
- System financing including pricing policies for the users sharing of costs;
- Technical programs;
- Establishment of private and international participation;
- Identification of facilities, hardware, and personnel that should be transferred; and
- Identification of actions such as executive orders and legislation required.

To gather information necessary for the preparation of the final transition plan, NOAA sponsored five conferences focused primarily on the needs of present and potential non-federal users of land remote sensing satellite data. (Federal user requirements are being assembled separately and were not a major topic of discussion at these conferences.) State and local governments, corporate end-users, value added service companies, research and academic interests, and individual users and interpretation practitioners were asked to express their needs at these meetings. A full understanding of these needs will assist NOAA in specifying the future operational system.

These conferences will also assist NOAA in developing future pricing policies for land remote sensing satellite data. Data pricing policies are of concern to all present and future users. Prices for the data and products from NASA's experimental Landsat system have been very low, covering only the direct costs of processing requests and of making reproductions. It is expected that this minimum pricing approach will not be maintained when the operational program begins in the late 1980's, particularly if the President's commitment to the eventual private sector operation of the fully operational system becomes a reality. The final transition plan will address this issue and propose data pricing options.

2. STRUCTURE OF THE CONFERENCES

The five user conferences were held in March, 1980, at the following locations:

Seattle, Washington	March 14
Chicago, Illinois	March 17
Tallahassee, Florida	March 21
Washington, D.C.	March 25
Albuquerque, New Mexico	March 28

Each conference followed a similar format in that the morning sessions were devoted to presentations by NOAA and NASA, outlining the material presented in the previous sections of this report, and the after sessions were concerned primarily with obtaining feedback from the users on their needs for land remote sensing data. The agenda for a typical meeting is shown below:

Agenda

Morning

- Welcoming Address
- Implementing Presidential Decisions
- NOAA/NESS – its Previous and New Roles
- Landsat Program Status
- Planning – from Today's Landsat to the Future Operational System
- NASA's Continuing Role

Afternoon

- Current Understanding of Non-federal Requirements
- Topical Group Meetings – to Gather Requirements
- Review of Findings
- Closing Discussions

As seen in the agenda, the primary focus of the afternoon sessions was the Topical Group meetings. At each conference, three such groups were formed. These groups addressed issues related to:

- Non-renewable Resources,
- Renewable Resources, and
- Planning/Environmental Management.

At the conclusion of the 1½ hour working group meetings, each session leader was asked to present a 15-20 minute summary of the topics addressed and the conclusions reached by his group.

In addition to the user inputs provided at the conferences, questionnaires were given to each attendee to be returned after the conferences. These questionnaires requested more detailed information about user requirements than could be obtained at the meetings. The results obtained from the questionnaires, in addition to the information from the conferences, will be used to formulate the transition plan and to design the operational system. A sample questionnaire is shown in Appendix C.

3. PARTICIPATION OVERVIEW

Five, one-day, informational conferences were conducted by the National Oceanic and Atmospheric Administration/National Environmental Satellite Service (NOAA/NESS) during March, 1980. A total of 550 individuals attended the conferences with:

- 17.2% in Seattle, Washington (March 14, 1980)
- 9.5% in Chicago, Illinois (March 17, 1980)
- 9.0% in Tallahassee, Florida (March 21, 1980)
- 48.8% in Washington, D.C. (March 25, 1980)
- 15.5% in Albuquerque, New Mexico (March 28, 1980)

The types of organizations/businesses represented at the conferences included:

- 17.1% from academic institutions
- 38.9% from private industry or non-profit organizations
- 11.6% from local and state governments
- 28.9% from Federal government agencies
- 3.5% from foreign governments

The following pages present detailed listings of these organizations and businesses.

Following are the Academic Institutions (Colleges and Universities) represented at the NOAA/NESS conferences.

Alabama A & M University
Butler University
California State College – Bakersfield
California State College – Dominguez Hills
California State Polytechnic University
California State University – Chico
California State University – Hayward
Central Washington University
Clemson University
Florida State University
George Washington University
Georgia Southwestern College
Georgia Tech
Hunter College
Louisiana State University
Michigan State University
Mississippi State University
New Mexico State University
Northwestern Michigan College
Ohio State University
Oregon State University
Prairie View A & M University
Purdue University
Southern Illinois University
Tacoma Community College
University of Alaska
University of Albuquerque
University of Arizona
University of California – Berkeley
University of California – Riverside
University of Chicago
University of Florida
University of Georgia
University of Kansas
University of Maryland
University of Massachusetts
University of Michigan
University of Minnesota
University of Nebraska
University of New Mexico
University of Puget Sound
University of South Carolina
University of Southern California
University of Tennessee

University of Texas – Permian Basin
University of Vermont
University of Washington
University of Wisconsin
Washington State University
Western Washington University

Following are the private industry and non-profit organizations represented at the NOAA/NESS conferences.

AMAF Industries
AMOCO
ARCO
AVCO Research Labs
American Institute of Aeronautics & Astronautics
American Petroleum Institute
American Society of Photogrammetry
Ampex Corporation
Aquitaine Mining Corporation
Atmospheric Environmental Service
Audio-Visual Institute
Automated Sciences Group, Inc.
The BDM Corporation
Battelle Northwest Laboratories
Bausch & Lomb
Bechtold Satellite Technology Corporation
Boeing
Boise Cascade
Computer Contractors Corporation
Computer Sciences Corporation
Computer Sciences Technicolor Associates (CSTA)
Comsat General
Cotton, Inc.
Council of State Planning Agencies
Daedalus Enterprises
Dames & Moore
D'Appolonia
A.W. Douglas & Associates
E G & G
ERIM (Environmental Research Institute of Michigan)
ESCA-TECH Corporation (Earth Science Consulting & Technology)
EXXON
Earth resources Observatory, Inc.
Earth Satellite Corporation
Eastman Kodak
Executive Resource Associates, Inc.
Exotech, Inc.
Falcon R & D
First Computer Corporation
Florida Power & Light
Fugro Northwest
General Electric
Geosat Committee
Geospectra Corporation
Gold Kist, Inc.

Goodyear Aerospace Corporation
Greenhorne & O'Mara
Gulf Canada Resources, Inc.
Harzo Engineering Company
Honeywell
Hughes Aircraft
ITEK
ITT
International Mapping Unlimited
Jones associates, Inc.
Peter Kiewit Sons Company
Lincoln Engineering
Lipman, Inc.
Arthur D. Little, Inc.
Lockheed
M & S Computing
MFA, Inc.
McDonald, Dettwiler & Associates
Majower Associates
Martel Labs
METRICS, Inc.
Mississippi R & D Center
Mitre Corporation
NAC, Inc.
National Geographic Magazine
The Nature Conservancy
Nautilus Press, Inc.
New Mexico Research Institute, Inc.
OAO Corporation
Occidental Oil Shale, Inc.
Ocean Data Systems
Operations Research Institute
Pacific Science Center
Phillips Petroleum Company
Phoenix Associates
Potlatch Corporation
Public Technology, Inc.
RCA
Ranchers Exploration & Development Corporation
Ritland Associates
SRI International
Sandia National Labs
Sangamo Weston
Sante Fe Railroad
Satellite Week
Robert E. Schillings & Associates
Science News
Scientific Atlanta

Sea Technology
Sea Use Council
Shell Oil Company
C.S. Smyth, Inc.
Spectrac Data
STAR, Inc.
St. Regis Paper Company
Sunmark Exploration Company
Systematics General Corporation
Systems & Applied Sciences Corporation
Systems Development Corporation
Technicolor Graphics Service, Inc.
TeLFree
Texas Instruments, Inc.
Texas Natural Resources Information System
Topographic Sciences Corporation
Trembly Associates
Turner, Collie, Braden, Inc.
Union Oil of California
WCTV-TV
Whidbey Island Navy Flying Club
World Bank

Following are the local and state government agencies represented at the NOAA/NESS conferences.

Alaska—

South Central Remote Sensing Project

Delaware—

Department of Natural Resources

Florida—

Division of Forestry

Department of Transportation

Aerial Mapping & Remote Sensing

Bureau of Land & Water Management

Office of the Governor

Swanee Water Management District

Georgia—

Department of Natural Resources

Southwest Georgia Areawide Planning Development Commission

Idaho—

Division of Management & Budget

Division of Economic Resources & Community Affairs

Illinois—

Division of Forestry

State Water Survey

Southwest Illinois Metro. & Regional Planning Commission

Chicago Aerial Survey

Iowa—

Iowa Geological Survey

Maryland—

Frederick County Planning Commission

Baltimore Regional Planning Council

Massachusetts—

State Legislature

Michigan—

State Legislature

Minnesota—

Geological Survey

Nebraska—
Missouri River Basin Commission

Nevada—
Division of Water Planning
Bureau of Mines & Geology

New Mexico—
State Engineering Office
Natural Resources Department

Oregon—
Forestry Department

Pennsylvania—
Department of Environmental Resources

South Carolina—
Land Resources Conservation Commission
Division of Research & Statistical Services

South Dakota—
State Planning Bureau

Virginia—
Department of Agriculture
Piedmont Planning District Commission

Washington—
Department of Natural Resources
Department of Transportation
State Planning & Community Affairs Agency
Department of Game
King County Planning Commission
King County Building & Land Development
King County Community Development
Spokane County Planning Department
Tacoma City Planning
Quinault Indian Nation

National Conference of State Legislatures

The following agencies within the Federal government were represented at the NOAA/NESS conferences.

NOAA—

- Office of the Deputy Administrator
- Office of the Associate Administrator
- Office of the General Counsel
- NESS
- National Ocean Survey
- Cartographic Branch
- Horizontal Branch
- Vertical Branch
- National Weather Service
- Technology & Commercial Development
- National Geodetic Information Center
- Office of Systems Engineering
- Office of Operations
- Solid Earth Geophysics Division
- Environmental Data & Information Service
- System Planning Group

NASA—

- Goddard Space Flight Center
- Kennedy Space Center
- Headquarters
- National Space Technology Lab
- Goddard Institute for Space Studies
- International Affairs
- Ames Research Center
- Jet Propulsion Lab
- Technology Applications Center

Department of the Interior—

- Bureau of Land Management
- U.S. Geological Survey
- National Park Service
- Fish & Wildlife Service
- EROS Data Center

Department of Energy--

- Office of Energy Research
- Bonneville Power Administration

Department of Agriculture—

- Soil Conservation Service
- Forest Service
- Federal Crop Insurance Administration

Department of State—
 INR/RGE
 Agency for International Development
 Central Intelligence Agency

Department of Defense—
 Army Corps of Engineers
 Defense Mapping Agency
 Defense Mapping School

General Services Administration—
 National Archives

U.S. Congress—
 U.S. Senate
 U.S. House of Representatives
 General Accounting Office

Smithsonian Institution—
 National Zoo

Office of Management and Budget

National Science Foundation

The following representatives from foreign governments attended the NOAA/NESS conferences.

Australian Embassy – Assistant Counselor Defense Science

Brazilian Embassy

Canadian Center for Remote Sensing

Geological Survey of Canada

Czechoslovak Embassy – Head of Scientific Section

European Space Agency

French Embassy – Scientific Attache

French Scientific Mission

Indian Meteorological Department

Embassy of India – First Secretary Space

Taiwan – Civilian Ministry

United Nations

D. NOAA'S PERCEPTION OF USERS' NEEDS

1. INTRODUCTION

In preparation for the five workshops, NOAA prepared a comprehensive data base of all known user requirements for land satellite remote sensing data. These needs were derived from numerous sources including: the Integrated Remote Sensing Systems Study (IRS³) for federal requirements, the Intergovernmental Science Engineering and Technology Advisory Panel (ISETAP) report, State and Local Government Perspectives on a Landsat Information System, for state and local requirements, the Geosat Committee Report, Geological remote Sensing from Space, for some of the private sector requirements, and Resource Sensing from Space, Prospects for Developing Countries by the National Academy of Sciences for foreign requirements. Many other sources were also accessed including those in Table 1 and personal contacts with various federal agency representatives and others.

Since all previous statements of users' needs have been in the context of a Landsat research and development program, a major thrust of the conferences was to get attendees to reaffirm previously stated needs and/or to present additional data needs in the context of an operational land satellite program. To this end, the afternoon working groups, organized along discipline lines, were asked to respond to the needs as presently understood. This process and the results of the group meetings will be presented in the next chapter.

2. DATA BASE CREATION AND UPDATE

NOAA's objectives in creating the user needs data base were to record and compile user requirements for the operational system in a consistent format that would facilitate various studies and tradeoffs. Specifically the data base was organized to:

- Identify groups of end users who have common needs for particular sets of system performance characteristics;
- Identify those user requirements which should drive the design of the spacecraft sensors—spectral bands, resolution (IFOV), pointability, etc.;
- Identify those needs which should govern the number of operational satellites, selection of orbits, etc.; and
- Estimate the volume of data needed to meet users' requirements— this is essential for the Systems Concepts Group to design the most efficient satellite and ground systems.

The estimates of the required data volumes are not intended to indicate the potential market for land satellite data products, but represent the number of unique scenes desired by various user groups so as to size the ground processing systems. These scenes may be presented on film, on computer compatible tapes or on some other distribution media not yet available. They are also useful for preliminary price sensitivity studies and analyses of system financing alternatives. Furthermore, these are estimates for the late 1980's and not current estimates.

The contents of the data base as of March 1, 1980, were summarized in charts and presented to the working groups for their evaluation. On the basis of the responses from the working groups at the conferences and other inputs, the data base has been modified to more closely reflect the users perceptions of their needs for operational land satellite remote sensing data.

The contents of the revised data base are summarized in Tables 2, 3, 4, and 5. These charts represent the contents of the data base as of April 1, 1980, and contain all revisions made as a result of the conferences.

Table 1. Studies Used to Create User Needs Data Base

Geobase Information System Impacts on Space Image Formats, edited by D. S. Simonett, et al., Santa Barbara Remote Sensing Unit, University of California, Santa Barbara, April 1978, NASA Contract NASW-3118.

Program on Earth observation Data Management Systems (EODMS), Center for Development Technology, Washington University, St. Louis, Missouri, (3 volumes) December 1976, NASA Contract NAS5-20680.

Land Satellite Project, Study by the Staff of the U.S. General Accounting Office, January 31, 1976.

Applications of Remote Sensing Data, Technology Applications Center, University of New Mexico, June 1974.

Survey of Users of Remote Sensing Data, Battelle Columbus Laboratories, G. E. Wukelic, et al., March 1976.

Integrated Use of Landsat Data for State Resources Management, Council of State Governments, Bill Schneider, 1980.

Total Earth Resources System for Shuttle Era, General Electric Company, March 1975, NASA Contract

AIAA/NASA Landsat Follow-on Conference, Abridged and Edited Remarks, Russel L. Schweickart, May 28, 1976.

Stereo Satellite Data Product Market Assessment, Geosat Committee Stereosat Task Force, November 1978.

Management of Satellite Acquired Earth Resource Data - Recommendations from the User Community, Parts I and II, The Data Management Subcommittee of the Geosat Committee, Inc., November 1978 and December 1979.

Preliminary Stereosat Mission Description, Jet Propulsion Laboratory, California Institute of Technology, May 1979.

A Summary of the Users Perspective of Landsat D and Reference Document of Landsat Users, NASA Office of User Affairs, Office of Applications, January 1977.

Remote Sensing Market Survey and Update, METRICS, INC., 1975 and 1976.

Landsat Follow-on: A Report by the Applications Survey Groups, Vol. I and II, Jet Propulsion Laboratory, California Institute of Technology, December 1976, Technical Memorandum, 33-803.

Resource Sensing From Space, Prospects for Developing Countries, National Academy of Sciences, 1977.

State and Local Government Perspectives on a Landsat Information System, Prepared by the Natural Resources and Environmental Task Force of the Intergovernmental Science, Engineering, and Technology Advisory Panel (ISETAP), June 1978.

Selected Proceedings of the National Conference of State Legislatures' Legislative Workshops on State Uses of Satellite Remote Sensing, NCSL, 1977.

International Remote Sensing Activities, METRICS, INC., 1977.

Geological Remote Sensing from Space, F. B. Henderson III and G. A. Swann, Editors, The Geosat Committee, Inc., May, 1976.

Landsat Remote Sensing Market Forecast, METRICS, INC., 1979.

MAJOR SOURCES OF USER REQUIREMENTS

- **FEDERAL AGENCIES:**
 - DEPARTMENT OF AGRICULTURE
 - DEPARTMENT OF COMMERCE
 - DEPARTMENT OF INTERIOR
 - NATIONAL AERONAUTICS AND
SPACE ADMINISTRATION
 - CORPS OF ENGINEERS
- **PRIVATE SECTOR USERS**
- **STATE AND LOCAL GOVERNMENTS**
- **FOREIGN USERS**

MAJOR SOURCES OF USER REQUIREMENTS

- FEDERAL AGENCY REQUIREMENTS ARE NOT COMPLETE. REQUIREMENTS FOR AGENCIES SUCH AS DoD, EPA, HUD, ETC. NEED TO BE DEFINED.
- PRIVATE SECTOR USER REQUIREMENTS REFLECT THE GOVERNMENT'S PERCEPTION OF NEEDS BASED ON EXISTING STUDIES AND PROJECTIONS, REVISED AS A RESULT OF THE MARCH, 1980 WORKSHOPS.
- STATE AND LOCAL GOVERNMENT REQUIREMENTS ARE BASED ON ISETAP REPORTS AND OTHER DOCUMENTATION, REVISED AS A RESULT OF THE MARCH, 1980 WORKSHOPS.
- FOREIGN USERS DO NOT INCLUDE FOREIGN GOVERNMENTS. THE REQUIREMENTS INCLUDED HEREIN ARE BASED ON PROJECTIONS OF FOREIGN COMMERCIAL DEMAND.

PRELIMINARY SUMMARY OF REQUIREMENTS FOR LAND REMOTE SENSING

- SPATIAL RESOLUTION INCLUDES TWO FIGURES TO REPRESENT OPTIMUM AND MINIMUM ACCEPTABLE.
- SPECTRAL BANDS ARE BASED ON THOSE SPECIFIED FOR THE MULTI-SPECTRAL SCANNER (MSS) AND THE THERMATIC MAPPER (TM). SPECIFICALLY THE BANDS ARE:

MULTI-SPECTRAL SCANNER

- 0.5 to 0.6 μm (green)
- 0.6 to 0.7 μm (red)
- 0.7 to 0.8 μm (near infrared)
- 0.8 to 1.1 μm (near infrared)

THERMATIC MAPPER

- 0.45 to 0.52 μm (blue-green)
- 0.52 to 0.60 μm (green)
- 0.63 to 0.69 μm (red)
- 0.76 to 0.90 μm (near-infrared)
- 1.55 to 1.75 μm (near-infrared)
- 2.08 to 2.35 μm (near-infrared)
- 10.40 to 12.50 μm (thermal infrared)

- TIMELINESS REPRESENTS DELIVERY TIME OF ACQUIRED DATA TO THE USERS, AND VARIES DEPENDING ON USER APPLICATION. THE PERCENT NOTATION REFLECTS PERCENTAGE OF USERS SPECIFYING THOSE DELIVERY TIMES.
- REPEAT COVERAGE VARIES WITH USER APPLICATION AND IS AFFECTED BY CLOUD COVER.
- ESTIMATED ANNUAL DATA VOLUME INDICATES A RANGE TO REFLECT HOW USER NEEDS MAY VARY DEPENDING ON THE AVAILABILITY OF OPTIMUM VERSUS MINIMUM ACCEPTABLE SPATIAL RESOLUTION.
- THESE DATA VOLUME NUMBERS ARE THE APPROXIMATE NUMBER OF SCENES THAT WILL NEED TO BE PROCESSED TO THE POINT WHERE AN END-PRODUCT CAN BE PREPARED (I.E., COMPUTER COMPATIBLE TAPES, IMAGES). NO ESTIMATE HAS BEEN MADE OF THE NUMBER OF PRODUCTS THAT MAY BE SOLD.

TABLE II-2
PRELIMINARY SUMMARY OF REQUIREMENTS
FOR LAND REMOTE SENSING (All Domestic User)
 (Based on Available Data as of April 1, 1980)

PROGRAMMATIC CATEGORY GROUPS

Performance Parameter	Renewable Resources	Non-Renewable Resources	Planning/Environmental Management
Spatial Resolution (Meters)	Range 2-80 m; 10-30 m Most Useful 2-30 m meets 90% of Requirements 30-80 m meets 10% of Requirements	Range 3-100 m; 30-80 m Most Useful 3-30 m meets 30% of Requirements 30-80 m meets 70% of Requirements	10-80 m; 10-30 m Most Useful 10-30 m meets 60% of Requirements 30-80 m meets 40% of Requirements
Spectral Bands	MSS/TM Type Plus Microwave	MSS/TM Type Plus Microwave	MSS/TM Type
Timeliness (Observation to User, Days)	2 Days — 15% <u>1/</u> <u>2/</u> 2-7 Days — 50% 7-30 Days — 35%	30 Days 100%	2-7 Days — 40% <u>1/</u> <u>2/</u> 7-30 Days — 60%
Repeat Coverage Cycle (Days)	5-7 Days — During Growing Season Seasonal at Other Times <u>2/</u>	Seasonal	Seasonal
Area Coverage	Global Capability	Global Capability	Domestic Capability
Stereo Coverage	Needed for 20% of the Requirements	Needed for 35% of the Requirements	Needed for 15% of the Requirements
Estimated Annual Data Volume (185 KM Square Scenes)	22,000 to 29,000	15,000 to 19,000	4,000 to 6,500

1/ Very rapid data delivery is required for observations over areas affected by major hurricanes, floods, earthquakes, pollution events, and similar episodes.

2/ Most critical requirements are for data which is used by the government or industry in regional or global crop condition assessment and production forecasting.

TABLE II-3
PRELIMINARY SUMMARY OF FEDERAL
REQUIREMENTS FOR LAND REMOTE SENSING
(Based on Available Data as of April 1, 1980)

Performance Parameters	Percent of Requirements Specifying Value	
	Optimum Value	Minimum Acceptable Value
Spatial Resolution (Meters)	10 m – 70% 30 m – 28% 80 m – 2%	10 m – 25% 30 m – 20% 80 m – 55%
Spectral Bands	TM Type – 100%	MSS-Type – 100%
Timeliness (Observation to Users; Days)	1 Day or Less – 14% ^{1/} 2 Days – 28% ^{2/} 3 to 14 Days – 45% More Than 14 Days – 13%	1 Day or Less – 2% ^{1/} 2 Days – 16% ^{2/} 3 – 14 Days – 42% More Than 14 Days – 40%
Repeat Coverage Cycle (Days)	Complete Seasonal Coverage for Non-Renewable Resources, 4 to 8 Days for Other Users ^{2/}	Same as Optimum Requirements
Area Coverage	Global Capability	Global Capability
Stereo Coverage	Needed for 20% of Requirements	Needed for 20% or Requirements
Estimated Data Volume (185 KM Square Scenes)	Up to 50,000	Up to 30,000

^{1/} Very rapid data delivery is required for observations over areas affected by major hurricanes, floods, earthquakes, pollution events, and similar episodes.

^{2/} Most critical requirements are for data which is used by the government or industry in regional or global crop condition assessment and production forecasting.

TABLE II-4
PRELIMINARY SUMMARY OF STATE/LOCAL GOVERNMENT
REQUIREMENT FOR LAND REMOTE SENSING
(Based on Available Data as of April 1, 1980)

Performance Parameters	Percent of Requirements Specifying Value	
	Optimum Value	Minimum Acceptable Value
Spatial Resolution (Meters)	10-30 m — 42% 30-50 m — 50% 80 m — 8%	30 m — 6% 80 m — 94%
Spectral Bands	TM Type — 100%	MSS Type — 100%
Timeliness (Observation to Users; Days)	4 Days — 46% ^{1/} 14 Days — 54%	4 Days — 33% ^{1/} 21 Days — 42% 60 Days — 25%
Repeat Coverage Cycle (Days)	7 — 9 Days ^{2/}	Seasonal
Area Coverage	Domestic U.S.	Domestic U.S.
Stereo Coverage	Needed By 13%	None Specified
Estimated Annual Data Volume (185 KM Square Scenes)	2000 — 4000	

^{1/} Very rapid data delivery is required for observations over areas affected by major hurricanes, floods, earthquakes, pollution events, and similar episodes.

^{2/} Most critical requirements are for data which is used by the government or industry in regional or global crop condition assessment and production forecasting.

TABLE II-5
PRELIMINARY SUMMARY OF U.S. PRIVATE INDUSTRY REQUIREMENTS
(Based on Available Data as of April 1, 1980)

Performance Parameter	Domestic U.S. Coverage		Foreign Coverage	
	Optimum Values	Minimum Acceptable	Optimum Values	Minimum Acceptable
Spatial Resolution (Meters)	10 m — 64% 30 m — 36%	30 m — 71% 80 m — 29%	10 m — 71% 30 m — 29%	30 m — 80% 80 m — 14%
Spectral Bands	TM Type — 86% Radar — 14%	MSS-Type — 100%	TM Type — 100%	MSS-Type — 100%
Timeliness, Days (Observation to User)	^{1/} 2/ 2/ 2 Days — 14% 14 Days — 86%	14 Days — 72% 90 Days — 18%	2 Days — 17% ^{1/} <u>2/</u> 14 Days — 86%	14 Days — 14% 90 Days — 80%
Repeat Coverage Cycle (Days)	Complete Seasonal Coverage for Non-Renewable Resources; 7-9 Days for Other Applications ^{2/}		Same as for Domestic Coverage	
Area Coverage	Entire United States		Global Land Area Capability	
Stereo Coverage	Needed for 50% of Requirements		Needed for 50% of Requirements	
Estimated Annual Data Volume (185 KM Square Scenes)	2000 — 5000		8000 — 12000	

^{1/} Very rapid data delivery is required for observations over areas affected by major hurricanes, floods, earthquakes, pollution events, and similar episodes.

^{2/} Most critical requirements are for data which is used by the government or industry in regional or global crop condition assessment and production forecasting.

The data base itself is an evolving entity and will probably be revised again as the results of the questionnaires are fully evaluated and integrated into the data base. As indicated previously, NOAA's entire planning process is interactive and, therefore, subject to modification on the basis of new, validated user requirements.

3. SUMMARY

One of the important results of the series of user conferences has been the modification of the user requirements data base. Another benefit has been the initiation of a dialogue between NOAA and land satellite data users. The third major benefit from the conferences was the reports from the working groups, which will be described in detail in the next section.

E. SUMMARY OF WORKING GROUP SESSIONS

1. ORGANIZATION OF WORKING GROUPS

During the morning sessions of the conferences, a series of NOAA and NASA speakers discussed Presidential Directive/NSC-54 and the events leading up to its adoption in November, 1979. This decision directs NOAA to determine user requirements for and implement a program leading to an operational land remote sensing satellite system. NOAA is required to produce a time-phased transition plan for this program and submit it to the Office of Management and Budget by June 1, 1980. While there have been numerous surveys of user needs in the past, these generally have been in the context of a research and development satellite program. Now that the land remote sensing satellite program is to become operational, it is necessary to reaffirm previously stated needs and to identify additional data needs in the next context.

To accomplish this, a two-step process is being used. First, the afternoon session of the NOAA regional meetings consisted of an explanation of the various non-federal land remote sensing data requirements as understood from previous inputs to NASA and other agencies. After NOAA's current understanding of requirements was presented, the audience broke into three topical discussion groups along the following lines:

- Renewable resources—includes agriculture, forestry, general vegetation, range lands, and related applications;
- Non-renewable resources—includes applications related to geologic structure, oil and mineral resources, geothermal areas, engineering geology, gravity, and magnetics; and
- Planning/environmental management—includes applications related to land use, environmental impact, mapping, hydrologic resources, and coastal zone monitoring.

A complete list of programmatic categories in each group is given in Table 6.

The second part of the process for updating the understanding of user needs consists of a questionnaire which conference attendees were asked to complete after returning home from the conference. These questionnaires will allow each user or potential user to express their data needs in detail, and will facilitate the design of the operational satellite system. Appendix C contains a copy of the questionnaire and instructions for its completion.

2. TOPICAL GROUP MEETINGS

In order that each group respond in a manner that the other groups could relate to, a common discussion format was desirable. This was not intended to limit the items for discussion or the responses of the group, but to provide some structure to the examination of system requirements that are likely to be important to users.

The working groups consisted of persons from all types of organizations—federal, state, and local governments, commercial concerns, and academic institutions. All persons in attendance participated in the discussions, but the outputs from the working groups represented a consensus of the views and opinions of the non-federal users. Other mechanisms were established to determine the needs of federal agency users.

During the scheduled hour and a half discussions, the working groups produced two outputs that were reported to the entire audience at the end of the individual sessions. These outputs, which were used in preparing inputs to the transition plan, are:

TABLE 6
LAND REMOTE SENSING PROGRAMMATIC CATEGORIES

RENEWABLE RESOURCES	NON-RENEWABLE RESOURCES	PLANNING/ENVIRONMENTAL MANAGEMENT
Crop Inventory	Geologic Structure	Land Use/Cover Classification
Crop Yield	Landforms	Land Use/Cover Change
Crop Condition	Lithology	Environmental Impact
Crop Irrigation	Thermal Anomalies	Coastal Zone Monitoring
Agricultural Episodal Event	Geobotanic Anomalies	Currents (Near Shore)
Soil Classification	Topography	Tides
Soil Erosion	Gravity Fields	Bathymetry
Soil Moisture	Magnetic Fields	Ocean Pollution
Forest Inventory		Drainage Patterns
Forest Stand Evaluation		Inland Water Inventory
Forest Condition		Snow Pack Parameters
Forest Episodal Event		Ice (Inland and Near Shore)
Range and Natural Vegetation Inventory		Water Quality (Inland and Near Shore)
Range Forage Condition		Wetland/Estuaries Inventory
Range Episodal Event		Hydrologic Episodal Event
		Wildlife Habitat Inventory
		Wildlife Habitat Evaluation

- A statement of agreement or disagreement with the perceived user needs, and, if disagreement, suggestions on how the draft statements should be changed; and
- An identification of those parameters (such as those listed below) that are considered to be most important to the operational use of land remote sensing data.

Copies of the graphics presented before the topical groups convened were available to all participants. These graphics showed the general requirements as they were understood on March 1, 1980, with separate statements for state and local governments and commercial end users. Since the value added service (information extraction) companies perform services for these and other end users, no special analysis was made for the needs of this part of the commercial community.

Since the format of the graphics may not have provided a clear opportunity for the users to comment on specific system performance characteristics that are of particular importance to their applications, the working groups, within the available time, were asked to identify where possible their requirements for:

- Spatial resolution (meters)
- Spectral requirements (radar, ultraviolet, visible near-infrared, thermal infrared; other details re intervals, etc.)
- Data delivery times (either from time of acquisition or from time of receipt of order for archived data)
- The ability to task the satellite system for coverage and the prior notice required for tasking
- Data pricing policy
- Period of time for which data should be archived
- Data continuity
- The ability to satisfy federal program requirements specified by law or regulation (i.e., relating to the environment, land use, etc.) through appropriately processed land satellite data
- The role of the value added service industry in meeting the information requirements of non-federal end users
- Other.

During the group discussion, each group leader was assisted by a rapporteur who took notes on the discussion and assisted the leader in preparing a 15 minute summary of key points for presentation to the entire audience. It was possible to cover only the highlights of the group discussions during the 15 minute presentations. Each group leader, however, was invited to write up the results of his session in the form of a discussion paper for later submission to NOAA.

3. RESULTS OF THE WORKING GROUP SESSIONS

As mentioned in the last chapter, the NOAA data base has already been modified to take account of the direct reaction of the working groups to the perceived user needs as they existed in NOAA's data base prior to the conferences. The summaries of the modified data base were presented in the last chapter. The results presented in this chapter are extracted primarily from the working group's examination of their specific needs for spatial resolution, spectral resolution, data pricing, etc.

The results are presented in two parts. Those topics which affected all groups and for which there was some general consensus among all disciplines are discussed first. Next, there is a discussion of the topics which were pertinent to each individual discipline (e.g., renewable resources, non-renewable resources, and planning/environmental management) but not necessarily germane to the other groups.

Themes Common to All Groups

It is difficult to generalize the results of fifteen different working groups and provide a completely faithful summary of all positions. Thus it must be understood at the outset that what follows is, in fact, a representative view of the majority of the working group participants. There are, however, some dissenting opinions and those too have been taken into account. In the main, however, most participants agreed that NOAA had developed a reasonably good understanding of user requirements for land satellite remote sensing data.

As might be expected, the instantaneous field of view (IFOV) requirements varied from less than 10 meters to 80 meters or greater. However, three IFOV's seemed to satisfy the majority of the users:

- 80 meters to maintain continuity with the present MSS system,
- 30-40 meters to achieve better classification accuracies than are available at 80 meters, and
- 10 meters to be available on demand for limited areas and at a higher cost to the user.

There was agreement that the spectral bands provided on the MSS and TM satisfied the majority of requirements. In general, the TM band selections were thought to be an improvement over the MSS bands, but there was a substantial requirement for a continuation of the MSS bands. Other bands and sensors were requested, such as multispectral thermal and radar, but it was concluded that these sensors are best flown on separate satellites.

Several additional issues seemed to catch the attention of a majority of all the working groups. One of these was the idea of a formal private sector input to NOAA's planning process. While no definite agreement was reached, professional associations and/or a separate ad hoc committee were suggested. Also there was a strong desire to see increased technology transfer and training activities in the remote sensing area. Again, no one best mechanism has been identified but regional centers, universities, private companies and professional societies were all suggested. The third item that seemed to be of interest to the most groups was archiving of data. Most groups concluded that as much data as possible should be archived for as long as possible. There was specific concern with only archiving all data with less than X% cloud cover, because the good portions of a particular scene may be just what are desired. Finally, there was an overwhelming desire on the part of most participants to have a quick look capability for the operational system.

The following items were suggested by working groups in all three programmatic areas, but there was slightly less consensus on these than on the previous capabilities. First, fractional scene data and/or digital data delivered on alternative media were requested by several groups. It was suggested that such a move would reduce costs to the user as data prices increase. On the subject of data pricing, most groups concluded that price increases were acceptable provided that they were "reasonable" and that better service was provided at the higher data prices. Several groups suggested that premium prices would be acceptable for special services.

Tasking, for example, was one service that was desired by several groups, and most of these indicated a willingness to pay all costs associated with particularly important data collection services. Finally, there was a call for continuity of digital data formats as a means to reduce the software development and processing costs of the users. At the very least, better communications with users is necessary prior to changing the system. A generally voiced comment along these lines was: "You don't want to find out with a sudden blast one morning you can't read the tape."

One final theme that was sounded repeatedly by the industrial participants in the conferences was that, in order for them to survive in this business, the government must not compete with them. No general resolution of the problem was offered but there was a consensus that whatever industry/government bounds were established by the government, they must be clearly stated and faithfully followed.

Renewable Resource Themes

Most of the renewable resource working groups echoed the themes mentioned above, but they also identified some issues that impact them more than some other groups. First, it was stated that far more people are concerned with renewable resources than NOAA could possibly reach directly. Therefore, it was suggested that professional organizations in the areas of forestry and agriculture as well as farmers cooperatives and the like could more effectively reach this community.

The agricultural community, in particular, needs frequent access to the satellite data during certain critical periods. In fact, it was stated that any programmatic category denoted as "condition" has virtually a real-time data requirement. The general consensus seemed to be that 2-5 day repeat coverage cycles were needed during certain critical growing periods in some areas of the world.

There seemed to be more concern for continuity of MSS data in this category than in any of the others. There was also some concern for this continuity in the planning/environmental management groups. It appears that 80-meter resolution is entirely adequate for most agricultural areas in most parts of the world.

Finally, there was a request that simulated thematic mapper data (and any other type of sensor proposed for an operational system) be provided to users prior to its availability from space. This would allow users to experiment with it and provide definitive feedback as to its acceptability to various problems to NOAA prior to its operational availability.

Non-Renewable Resource Themes

With respect to spatial and spectral resolutions and frequency of coverage, these groups are almost the exact opposites of the renewable resource groups. While the 80-meter data are used because they are available, this discipline is much more interested in global 30-40 meter data, and, on demand, 10-meter data. Furthermore, monthly to seasonal data are all that is required to provide a sufficient frequency of coverage. On the other hand, the non-renewable resource groups are far more interested in additional spectral bands in the thermal infrared (with different equatorial crossing times) and in the radar portions of the spectrum. They are also adamant about the necessity for raw data from the satellites.

By far the biggest unmet need of this discipline area is for one-band, worldwide stereoscopic data. Other groups also indicated a need for stereo, but the geologic community, in particular, considers this their top priority for both exploration purposes and for engineering geologic investigations, including mapping.

Since the majority of the data acquired by these users is from foreign areas, they are very concerned about Landsat D not having a tape recorder. They reason that a failure of the TDRSS will put them at the mercy of foreign ground stations for data acquired over foreign areas. To a large extent, this is unacceptable from both a political and economic standpoint.

Finally, two points were raised by these groups that were not addressed by other disciplines. First, there does not appear to be anywhere within the federal government an agency that is concerned with worldwide resource exploration. Consequently, geologic exploration firms feel that not enough attention is paid to their needs for some of the data products that satellites could provide. They believe that the lack of a supporting federal agency hampers their cause. Also, the geologic community is actively working to get some of the classified data that is available within the government declassified. Some of these data, they feel, would be invaluable to their exploration activities.

Planning/Environmental Management Themes

With one exception, the data needs of these disciplines do not appear to drive the design of the operational satellite system: That need is for the TM Band 1 (blue-green) which is particularly important for hydrological and bathymetric programs. Most groups thought that the current

80-meter resolution was acceptable for many purposes and 30- to 40-meter resolution would suffice for many others. The current MSS and/or TM spectral bands appear adequate as do data delivery times in the 7-9 day range and coverage cycles in the 8-10 day range. Quick-look capability and/or 1-2 day data delivery, however, is desired for episodic events.

The one area where the needs of the planning/environmental management community seem to differ markedly from other disciplines is in satisfying the requirements of federal programs. In some instances where the current data are perfectly adequate (in the opinion of the state and local agencies) to fulfill federal program requirements, the various federal agencies have refused to allow its use. In this context, therefore, state and local agencies, particularly, see the need for 10-15 meter data to be available to satisfy these federally imposed requirements. They also desire a uniform federal policy among all agencies with respect to the use of land satellite data to meet federal program requirements.

In addition to the above, these groups seemed to have more support for the concept of regional centers to provide a wide range of data delivery, processing, and information extraction services. The exact mechanisms for providing these services were not addressed.

Finally, these groups shared the concern of other disciplines for saving as much archived data as possible for as long as possible. However, they thought that in any purge of the archives, census years deserved special attention due to the need, upon occasion, to merge Landsat data with other types of socioeconomic data.

4. SUMMARY

It does not appear that any one discipline dominates all requirements for land remote sensing satellite data. Agricultural interests are relatively well satisfied with the MSS bands and 80-meter resolution, although finer resolutions are desired over some areas. They require, however, an extremely close repeat coverage cycle in some areas of the world during the growing season. On the other hand, the geologic community has little need for data more frequently than monthly or seasonally but place great emphasis on more bands, better resolution, and stereoscopic data.

It appears, therefore, that a number of tradeoffs and compromises will be necessary in designing the operational land remote sensing satellite system. In making these decisions, however, all points of view will be carefully considered.

F. OVERALL BENEFITS DERIVED FROM CONFERENCES

A number of very important benefits were derived from these user conferences. First of all, they served to introduce NOAA and NESS to the non-federal land remote sensing satellite data users community and to explain NOAA's new role as the agency responsible for the U.S. civil operational land remote sensing program. Through this process, NOAA personnel were able to meet with the users and become personally acquainted with many of them and their concerns about the program.

Through the interactive medium of the conferences, the NOAA personnel, who are directly responsible for preparing the transition plan for OMB and for planning the operational land remote sensing satellite system, gained a first-hand knowledge of the data requirements in terms of spectral and spatial resolution, timeliness, repeat coverage cycles, and other important parameters. As seen in Chapter IV, this interaction has already lead to a modification of NOAA's data base of non-federal user requirements. The evolution of this data base will continue as new inputs are received through analysis of the questionnaires, through further definition and refinement of data needs by the user community, and through evaluations of proposed new concepts of data acquisition, delivery, and archiving.

In effect, these conferences have served to establish a dialogue with the user community. This dialogue is intended to evolve and grow in future years as NOAA begins to move from its present planning role into its more technical role as the agency responsible for day-to-day operations of the satellite system as well as planning for future satellite systems. NOAA will continue to receive suggestions and planning inputs from users throughout this process. Indeed, one of the purposes of these conferences was to solicit comments on alternative mechanisms for continuing this interaction. Some of the possibilities are discussed in Chapter VII.

Finally, the planning process for the U.S. operational land remote sensing satellite program has been described as a complex series of interactions between the data users, the Program Board, and the systems design/concepts groups. This interaction can only succeed through a spirit of cooperation on the part of all concerned. These conferences served to begin this cooperative effort which is expected to continue far into the future.

G. FUTURE PLANS FOR USER INTERACTION

It has been stated several times that these conferences were merely the first round in a series of interactions between NOAA and the users of land remote sensing satellite data. One of the suggested topics for discussion during the working group sessions was preferred mechanisms for future interaction between users and NOAA.

Among the interaction mechanisms suggested in the group meetings were:

- A NOAA-sponsored newsletter,
- Newsletters distributed by professional societies and similar groups,
- Professional and trade publications,
- Regional centers,
- A central inquiry/response facility,
- Seminars and workshops at professional society meetings,
- Academic institutions, and
- Training and technology transfer programs.

NOAA is actively considering all of these suggestions.

At the present time, not all of the alternatives have been reviewed and not all future interaction methods determined. However, the following plan has been proposed. There would be a second series of workshops with users after the transition plan is approved by OMB. These would be longer in duration (probably two days each) and the formats would be somewhat different. These conferences would also likely be held in different cities than the previous conferences, but no sites have been selected at this time.

Other mechanisms for continuing interactions are also being pursued. Several of the suggestions received at the conferences appear viable but no definite decisions have been reached. It is certain, however, that NOAA does intend to continue the user interactions already begun and to expand the necessary interfaces as rapidly as possible.

APPENDIX A

CURRENT STATUS OF LANDSAT

Landsat was launched in 1972 and operated very well for approximately five years—four years beyond its designed life. Substantial amounts of data were collected before it ceased operation in January of 1978. Landsat 2, the second satellite in the series, was launched in 1975. Data collection ceased in November, 1979, and satellite operations closed early this year. Landsat 3, which was launched in 1978, is still in operation although some difficulties in data collection have been experienced. Landsat D is currently under development and is planned for a 1982 launch. Landsat D' will be available for launch approximately six months after Landsat D.

Landsats 1 and 2 contained a multispectral scanner (MSS) with four wavelength bands and a return beam vidicon (RBV) system with three bands. These first two satellites were carbon copies, but Landsat 3 had some significant changes such as the addition of the thermal band on the MSS and higher resolution on the RBV. Landsat D will consist of a multispectral scanner with four bands, essentially the same bands used on the first two satellites, and a new thematic mapper (TM) with seven bands. Landsat D' will be a carbon copy of Landsat D.

The Landsat D system is quite a different spacecraft from the previous Landsats. A multi-mission spacecraft bus will be used for a variety of different satellite missions. Its antenna will point back to the Tracking and Data Relay Satellite System (TDRSS) antenna. The current plan is to transmit data back to the TDRSS antenna as the data are received. The original design of the spacecraft does not include tape recorders although that possibility still exists.

There are some significant differences in the Landsat D system requirements. Instead of an altitude of 914 kilometers, Landsat D will have an altitude of 705 kilometers. However, the design of the MSS has been changed such that the resolution remains approximately the same. The data rate is also approximately the same in order to insure proper continuity for users of previous Landsat data. The repeat cycle will be improved to about 16 days instead of 18 days. This kind of global coverage per day will provide approximately 200 MSS scenes through TDRSS and approximately 100 thematic mapper scenes. It is anticipated that worldwide there will be a direct readout of approximately 460 MSS scenes and probably 150 thematic mapper scenes. Turnaround time through the processing and data management system at Goddard is expected to be within 48 hours. This does not necessarily mean that from the time a customer orders a scene until the time he receives it is 48 hours. Such situations are dependent upon many more variables, and the system that does that is not completely defined yet.

A comparison of the two scanners on Landsat D shows the MSS with 80-meter resolution and four bands, two in the visible and two in the solar infrared. The MSS quantizes data into 64 levels. The TM essentially has 30-meter resolution with 120-meter resolution on the thermal band. The TM has seven bands, three in the visible, three in the solar reflected infrared, and one in thermal infrared. It has a quantization level of eight bits or 256 levels.

With respect to the data handling system, the current system consists of receiving the data from Landsat 3 at remote sites (e.g., Goldstone, California and Fairbanks, Alaska) and then retransmitting it via domestic communications relay satellite to Goddard Space Flight Center. Goddard has an antenna facility to receive directly off the satellite as well. At Goddard, the data are pre-processed, formatted, and then transmitted via domestic communications relay satellite to the EROS Data Center (EDC) at Sioux Falls, South Dakota, where they are received and recorded on high density digital tapes. EDC then produces data products for the users in the format of film, computer compatible tapes, or duplicate high density digital tapes.

One concept for how the data flow could exist under Landsat D would be to have all sensor data transmitted through the TDRSS down to the collection center at White Sands, New Mexico, which then relays it via the domestic communications satellite to Greenbelt, Maryland. After pre-processing, the data would be retransmitted via Domsat up to EDC as is currently done. Again, the customer interface would all be with EDC.

Regarding the Landsat ground receiving stations, two stations are operated by Canada, three by the U.S. (Fairbanks, Goldstone, and Greenbelt), and one each in Brazil, Sweden, Japan, India, and Italy. A memorandum of understanding was signed with Thailand in 1979 and an operational capability should be achieved some time in 1981. The same is true of the Peoples Republic of China. The Australian and Argentine stations have a limited operational capability right now. A memorandum of understanding has also been signed with Chili but so far they have not taken any steps to achieve an operational capability. Some interest has been expressed in the African stations, but currently nothing is yet underway.

APPENDIX B

LIST OF PARTICIPANTS

LIST OF PARTICIPANTS

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MARCH 17, 1980**

**TALLAHASSEE, FLORIDA
MARCH 21, 1980**

**WASHINGTON, D.C.
MARCH 25, 1980**

**ALBUQUERQUE, NEW MEXICO
MARCH 28, 1980**

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TABLE OF CONTENTS

I.	Academic Institutions	Pages 3 - 10
II.	Private Industry/Non-Profit	Pages 11 - 26
III.	Local and State Governments	Pages 27 - 32
IV.	Federal Government	Pages 33 - 45
V.	Foreign	Pages 46 - 47
VI.	NOAA/Land Remote Sensing Task Force	Page 48
VIII.	Human Resources Management, Inc.	Page 48

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APPENDIX C

LAND REMOTE SENSING NEEDS QUESTIONNAIRE

General Instructions for Completing Questionnaire

NOAA would like to get your opinions on a number of matters pertaining to the current and future land remote sensing satellite program in the U.S. This, of course, will not be your only chance to offer suggestions, comments, and technical inputs to NOAA's planning process. However, this may be your best opportunity to influence the transition plan that is to be presented to the Office of Management and Budget on June 1, 1980.

Responses from nonfederal data users are to be mailed to METRICS, INC., at the address specified below. These responses will be tabulated and statistically analyzed to provide data inputs for the transition plan. Responses from federal agencies may be mailed to your Federal Agency User Representative (list available) or to METRICS, INC. Federal responses mailed to METRICS, INC., will not be tabulated separately but will be forwarded to the appropriate agency contact.

Most of the information requested pertains to the operational period which will begin about 1988. However, some questions specifically request information about the transition period which extends from now until 1987. Please answer the questions with data appropriate to the transition period or operational period as requested.

The questionnaire is divided into two parts. We would appreciate your responding to both parts. If you choose to respond to only one part, please provide the data requested in Part I. Because of the detailed nature of the information requested, separate instructions are provided for Part I and for Part II.

If you have any questions about completing the questionnaire, please contact one of the following:

- * G. William Spann, METRICS, INC. (404) 955-1975
- * Nancy J. Hooper, METRICS, INC. (404) 955-1975
- * Wilbur H. Eskite, NOAA (202) 377-1400
- * George J. Ensor, NOAA (202) 377-1400
- * Daniel J. Cotter, NOAA (202) 377-1400

If other agencies or organizations, which are not represented at this or another conference, wish to complete and return a questionnaire, they are welcome to do so. Simply copy the questionnaire and accompanying instructions and pass them along. We do prefer, however, that for any individual agency or organization a unified response be prepared.

PLEASE RETURN YOUR QUESTIONNAIRE AS SOON AS POSSIBLE, BUT NO LATER THAN MAY 19, 1980, TO:

METRICS, INC.
290 INTERSTATE NORTH
SUITE 116
ATLANTA, GA 30339

LAND REMOTE SENSING NEEDS QUESTIONNAIRE

Instructions for Completing Part I

The following instructions are provided to clarify specific questions as necessary. Reference to these instructions, to the attached sheet giving MSS and TM parameters, and to the list of programmatic categories will assist you in completing the questionnaire.

Question 3. You may list actual spectral requirements or, alternatively, you may refer to MSS and/or TM capabilities, plus any additional spectral regions such as radar, etc.

Question 4. At present it is difficult, if not impossible, to have the Landsat system turned on over specific areas. In the future, this may not be so difficult. If this is important to you, please explain the nature of your needs.

Question 7. These data should indicate the total numbers of film images and digital scenes that your organization used or caused to be used on your behalf. That is, you should include any data processed for you by NASA, universities, or value added services companies, etc. Universities, other R&D organizations, and value added services companies should indicate separately data used for their own purposes, if any.

Question 10. Please estimate your data requirements to the best of your ability considering the current and future availability of MSS data and the future availability of TM data. For the purposes of responding to this question, assume that MSS prices will remain \$200 per scene on computer compatible tapes. If the present pricing policy is followed, TM digital data (CCT's) are likely to be \$300-400 per scene.

Questions 11 and 12. For the transition period, please indicate which portion of your data needs set forth in Question 10 it would be cost-effective to satisfy with satellite data at higher prices. Enter the estimated number of scenes that will be purchased at *each* price level.

Question 13. Recognizing that your data needs as well as the technological capabilities of satellites will change between now and 1988, please estimate, to the best of your ability, your data requirements in the operational time period. For the purposes of this question, assume that data prices will remain \$200 per scene on computer compatible tapes.

Questions 14 and 15. As stated at the conferences, the price of land remote sensing satellite data will increase in the future. Please indicate which portion of your data needs expressed in Question 13 it would be cost-effective to satisfy with satellite data at higher prices. Enter the estimated number of scenes that will be purchased at *each* price level.

Questions 17 through 25. Responses to these questions will not be analyzed statistically. However, your responses to these questions will impact portions of the transition plan, continued user interactions with NOAA, and future federal policies toward the operational uses of land remote sensing satellite data. Your opinions and suggestions will be given careful consideration in NOAA's planning process.

CHARACTERISTICS OF MULTISPECTRAL SCANNER (MSS) AND THEMATIC MAPPER (TM)

MULTISPECTRAL SCANNER (MSS)

Spectral Bands:	0.5 to 0.6 μm (green) 0.6 to 0.7 μm (red) 0.7 to 0.8 μm (near-infrared) 0.8 to 1.1 μm (near-infrared)
Spatial Resolution:	80 meters
Scene Size:	185x185 kilometers (100x100 nautical miles)

THEMATIC MAPPER (TM)

Spectral Bands:	0.45 to 0.52 μm (blue-green) 0.52 to 0.60 μm (green) 0.63 to 0.69 μm (red) 0.76 to 0.90 μm (near-infrared) 1.55 to 1.75 μm (near-infrared) 2.08 to 2.35 μm (near-infrared) 10.40 to 12.50 μm (thermal infrared)
Spatial Resolution:	30 meters, except thermal infrared band has 120-meter resolution
Scene Size:	185x185 kilometers (100x100 nautical miles)

LAND REMOTE SENSING PROGRAMMATIC CATEGORIES

RENEWABLE RESOURCES	PLANNING/ENVIRONMENTAL MANAGEMENT
Crop Inventory	Land Use/Cover Classification
Crop Yield	Land Use/Cover Change
Crop Condition	Environmental Impact
Crop Irrigation	Coastal Zone Monitoring
Agricultural Episodal Event	Currents (Near Shore)
Soil Classification	Tides
Soil Erosion	Bathymetry
Soil Moisture	Ocean Pollution
Forest Inventory	Drainage Patterns
Forest Stand Evaluation	Inland Water Inventory
Forest Condition	Snow Pack Parameters
Forest Episodal Event	Ice (Inland and Near Shore)
Range and Natural Vegetation Inventory	Water Quality (Inland and Near Shore)
Range Forage Condition	Wetland/Estuaries Inventory
Range Episodal Event	Hydrologic Episodal Event
Other (Explain)	Wildlife Habitat Inventory
	Wildlife Habitat Evaluation
	Other (Explain)

NONRENEWABLE RESOURCES

Geologic Structure
 Landforms
 Lithology
 Thermal Anomalies
 Geobotanic Anomalies
 Topography
 Gravity Fields
 Magnetic Fields
 Other (Explain)

LAND REMOTE SENSING NEEDS QUESTIONNAIRE

PART I

NAME _____

ORGANIZATIONAL AFFILIATION _____

ADDRESS _____

_____ ZIP _____

PHONE Area Code () _____

MAJOR RESPONSIBILITIES _____

THE RESPONSES TO THIS QUESTIONNAIRE REPRESENT:

_____ PROFESSIONAL JUDGMENT

_____ AGENCY/ORGANIZATION POSITION

_____ CONSORTIUM POSITION

PLEASE IDENTIFY MEMBERS OF CONSORTIUM

PLEASE ANSWER THE FOLLOWING QUESTIONS BASED ON YOUR OVERALL LAND REMOTE SENSING DATA NEEDS. IF YOU WISH TO ELABORATE ON YOUR RESPONSES, USE A SEPARATE SHEET OF PAPER. REFER TO THE SPECIFIC INSTRUCTIONS FOR EACH QUESTION AS NECESSARY. DETAILED REQUIREMENTS BY PROGRAMMATIC CATEGORY ARE REQUESTED IN PART II.

1. Using the attached list of programmatic categories as a guide, please list your highest priority categories which use (or are expected to use) land remote sensing data in the operational time period (post 1988).

1. _____
2. _____
3. _____
4. _____
5. _____

2. To meet your overall data needs in the operational period, what is the:

Optimum spatial resolution? _____ meters

Minimum acceptable spatial resolution? _____ meters

3. To meet your overall data needs in the operational period, what are the:

Optimum spectral bands? _____
_____ micrometers

Minimum acceptable spectral bands? _____
_____ micrometers

4. Do you need to be able to task the operational satellite system or otherwise specify data acquisition areas and times?

____ Yes ____ No If yes, please explain. _____

5. What operational data delivery times do you require:

From data acquisition? Optimum: _____ days

Minimum acceptable: _____ days

From the archives? Optimum: _____ days

Minimum acceptable: _____ days

6. In your opinion, how long should the data be archived?

Optimum: _____ years

Minimum acceptable: _____ years

7. How much Landsat data did your organization (or consortium) use in 1979?

Film Images: Purchased from EROS Data Center in 1979 _____ (number)

Acquired elsewhere in 1979 _____ (number)

Acquired prior to 1979 _____ (number)

Scenes on computer compatible tapes:

Purchases from EROS Data Center in 1979 _____ (number)

Acquired elsewhere in 1979 _____ (number)

Acquired prior to 1979 _____ (number)

8. If you used Landsat computer compatible tapes in 1979 that were acquired in 1979 from other than the EROS Data Center, please indicate the number of scenes acquired by source of data:

_____ Scenes from value added services companion

_____ Scenes from universities

_____ Scenes from R&D organizations (other than universities)

_____ Scenes from NASA

_____ Scenes from other federal agencies

_____ Scenes from foreign ground stations

_____ Scenes from other (e.g., state agencies, professional acquaintances, NASA principal investigators, etc.) _____

9. If you used Landsat computer compatible tape data in 1979 to support your activities, who processed the data to extract the information required? Please indicate the number of scenes by type of processing organization.

_____ Scenes by value added services companies

_____ Scenes by universities

_____ Scenes by R&D organizations (other than universities)

_____ Scenes by NASA

_____ Scenes by other federal agencies

_____ Scenes by your own organization

_____ Scenes by other (please specify by type of organization) _____

10. What average annual volume of digital data do you estimate will be required to satisfy your land remote sensing satellite data needs in the transition period (e.g., number of MSS equivalent (185 by 185 kilometer) scenes).

MSS Data: _____ Scenes

TM Data: _____ Scenes

11. What portion of your MSS data requirements stated above would you purchase if the price for a scene on computer compatible tapes is:

Two times present price (\$400) _____ (Number of scenes)

Three times present price (\$600) _____ (Number of scenes)

Four times present price (\$800) _____ (Number of scenes)

Five times present price (\$1000) _____ (Number of scenes)

Ten times present price (\$2000) _____ (Number of scenes)

12. What portion of your TM data requirements stated above would you purchase if the price for a scene on computer compatible tapes is:

Two times present price (\$400) _____ (Number of scenes)

Three times present price (\$600) _____ (Number of scenes)

Four times present price (\$800) _____ (Number of scenes)

Five times present price (\$1000) _____ (Number of scenes)

Ten times present price (\$2000) _____ (Number of scenes)

13. What average annual volume of digital data do you estimate will be required to satisfy your land remote sensing satellite data needs in the operational time period (e.g., number of MSS equivalent (185 by 185 kilometer) scenes)?

If optimum data requirements are met: _____ Scenes

If minimum acceptable data requirements are met: _____ Scenes

14. Assuming that your optimum operational data requirements are met, what portion of your data requirements stated above would you purchase if the price for a scene on computer compatible tapes is:

Two times present price (\$400) _____ (Number of scenes)
Three times present price (\$600) _____ (Number of scenes)
Four times present price (\$800) _____ (Number of scenes)
Five times present price (\$1000) _____ (Number of scenes)
Ten times present price (\$2000) _____ (Number of scenes)

15. Assuming that only your minimum acceptable operational data requirements are met, what portion of your data requirements stated above would you purchase if the price for a scene on computer compatible tape is:

Two times present price (\$400) _____ (Number of scenes)
Three times present price (\$600) _____ (Number of scenes)
Four times present price (\$800) _____ (Number of scenes)
Five times present price (\$1000) _____ (Number of scenes)
Ten times present price \$2000) _____ (Number of scenes)

16. What repeat coverage cycle do you require to satisfy your operational land remote sensing satellite data needs?

Optimum: _____ days

Minimum acceptable: _____ days

PLEASE ANSWER THE FOLLOWING QUESTIONS IN NARRATIVE FORM, USING ADDITIONAL SHEETS AS NECESSARY.

17. Is the range of standard data products now available from EROS Data Center suitable for your present needs? What changes and/or new products (a) do you require now?

(b) will you require in the future?

18. What should be the role of private enterprise in providing information extraction value added services to satisfy your continuing information requirements? What can the federal government do to assure the success of this role?

19. Most of the parameters of the U.S. satellite remote sensing program are already fixed for the duration of the transition period. Prior to the operational period, however, minor changes might be possible. What changes can you suggest for the transition period which will have the largest positive impact on your use of Landsat data?
20. What can the federal government do to increase the use of land remote sensing satellite data?
21. Are the currently available training opportunities (e.g., university short courses, professional societies, NASA Regional Centers, EROS Data Center, etc.) sufficient for your needs? If not, please explain.
22. What research and development data needs do you have that are not met by the operational needs you stated previously?
23. What mechanisms should NOAA establish to assure continuing interaction with nonfederal data users and responsiveness to their needs?

24. This workshop was intended to advise you of NOAA's new role as the implementing agency for the operational land remote sensing satellite program and to make available to you the opportunity to advise NOAA of your data needs in the new operational context. Do you think this was accomplished? Please explain. Should more of these workshops be held in the future? What changes would you suggest?
25. Assume that the French earth resources satellite, SPOT, is launched as scheduled in 1984 and provides 10 meter panchromatic, 20 meter multispectral, and stereo data of your areas of interest. How will this affect your use of Landsat MSS and TM data?

LAND REMOTE SENSING NEEDS QUESTIONNAIRE

PART II

Instructions for Completing Data Sheets

Referring again to the list of programmatic categories in Part I of the questionnaire, please fill out a copy of the attached data sheet for each of your highest priority categories (Question 1 in Part I). Alternatively, you may fill out a sheet for each of the three broader categories of requirements (e.g., renewable resources) that applies to your organization. All data supplied in completing Part II of the questionnaire should refer to your requirements in the operational time period (e.g., post 1988). Reproduce the form as many times as necessary to present your organization's data requirements.

The items below explain the nature of information required for each column. In addition, an example form has been prepared using the U.S. Department of Agriculture requirement for "crop inventory" data. Reference to these instructions and the example form will assist you in preparing your own data sheets.

COLUMN 1: KEY PERFORMANCE PARAMETERS

Enter the performance parameters needed by your organization for that programmatic category.

Examples: Spatial Resolution (meters)

Spectral Requirements (radar, ultraviolet, viable near infrared, thermal infrared; other details re intervals, etc.). Specify with numbers or by reference to current multispectral scanner or planned thematic mapper bands.

Stereo Coverage (if required)

Coverage Frequency (time between satellite overpasses)

Timeliness (time from acquisition to user)

Data Products

Other as appropriate.

COLUMN 2: COVERAGE

Indicate your requirements for domestic and/or foreign data and any differences between the two.

COLUMN 3: SIGNIFICANCE OF SATELLITE DATA

Enter significance of satellite data in this parameter category to agency requirements. The entry is one of three classes defined as:

- A. Can't accomplish agency job without satellite data;
- B. Data is useful and/or cost-effective but not essential;
- C. Not necessary (lack of data would not seriously degrade agency performance).

COLUMN 4: PARAMETER VALUES

Enter numerical values for two categories:

- A. Optimal value (considering practical constraints on your use of satellite data such as processing burden);
- B. Minimum acceptable values

COLUMN 5: ANNUAL VOLUME

Estimate number of equivalent MSS (e.g., 185 by 185 kilometer) scenes to be acquired annually. This number should indicate your estimate of annual requirements in the operational time frame, e.g., post 1988. *Please indicate in Column 6 What Portion of These Scenes are to be Acquired on Computer Compatible Tapes and What Portion are on Film.*

COLUMN 6: COMMENTS

Enter brief description of any items that modify entries or add information. Be sure to specify how many of your scenes need to be on film and on computer compatible tapes.

EXAMPLE

ORGANIZATION U.S. Department of Agriculture

PROGRAMMATIC CATEGORY:

RESPONDENT _____

Crop Inventory

PHONE NUMBER () _____

COLUMN 1		COLUMN 2		COLUMN 3	COLUMN 4		COLUMN 5	COLUMN 6
KEY PERFORMANCE PARAMETERS	COVERAGE REQUIREMENTS	DOMESTIC	FOREIGN	SIGNIFICANCE OF SATELLITE DATA	PARAMETER VALUES		ANNUAL VOLUME (SCENES)	COMMENTS
					OPTIMUM	MINIMUM ACCEPTABLE		
SPATIAL RESOLUTION (METERS)	X			B	<10 //////////	//////////	600	Minimum 5 Looks in Season
					//////////	10	300	
		X		A	10 //////////	//////////	3000	All Scenes on Tape
					//////////	30	2000	
SPECTRAL REGIONS (MICROMETERS)	X			B	.5 - .6 .6 - .7			
				A	.7 - .8 .8 - 1.1 2.0 - 2.2 10.5 - 12	.6 - .7 .8 - 1.1		
TIMELINESS (HOURS) OBSERVATION TO USER	X		X		24 24	72 120		Tasking Time: 24 hrs.
STEREO	X			B	60% overlap	25%	200	
OTHER (SPECIFY)								

ORGANIZATION _____

PROGRAMMATIC CATEGORY: _____

RESPONDENT _____

PHONE NUMBER () _____

COLUMN 1	COLUMN 2		COLUMN 3	COLUMN 4		COLUMN 5	COLUMN 6
KEY PERFORMANCE PARAMETERS	COVERAGE REQUIREMENTS DOMES- TIC	FOREIGN	SIGNIFI- CANCE OF SATELLITE DATA	PARAMETER VALUES		ANNUAL VOLUME (SCENES)	COMMENTS
				OPTIMUM	MINIMUM ACCEPTABLE		
SPATIAL RESOLUTION (METERS)							
SPECTRAL REGIONS (MICROMETERS)							
TIMELINESS (HOURS) OBSERVATION TO USER							
STEREO							
OTHER (SPECIFY)							

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